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Declaration

I, Michihiko Matsuba, President of Fukuyama Sangyo Honyaku Center, Ltd., of 16-3, 2-chome, Nogami-cho, Fukuyama, Japan, do solemnly and sincerely declare that I understand well both the Japanese and English languages and that the attached document in English is a full and faithful translation, of the copy of Japanese Patent Application No. Hei-10-277333 filed on September 30, 1998.

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STEREOSCOPIC PHOTOGRAPHIC SURVEYING TARGET

[What is claimed is]

[Claim 1] A stereoscopic photographic surveying target that is photographed by a camera together with a subject in photogrammetry, has reference points which are easily distinguished in a shooting image, and is used for calculating the shooting position of said camera by specifying the positions of said reference points in said shooting image,

wherein first, second and third three reference points, the intervals of which are known in advance, are provided as said reference point, a first straight line connecting said first reference point and said second reference point to each other and a second line connecting said second reference point and said third reference point to each other have a prescribed angle, and an auxiliary point which is easily distinguished in the shooting image as in said reference points is provided on said first straight line and said second straight line.

[Claim 2] The stereoscopic photographic surveying target as set forth in Claim 1, wherein the distance between said first reference point and said second reference point is equal to that between said second reference point and said third

reference point.

[Claim 3] The stereoscopic photographic surveying target as set forth in Claim 1, wherein said prescribed angle is a right angle.

[Claim 4] The stereoscopic stereoscopic photographic surveying target as set forth in Claim 1, wherein said first reference point, said second reference point and said auxiliary point are positioned equidistantly from each other on said first straight line, and said second reference point, said third reference point and auxiliary point are positioned equidistantly from each other on said second straight line.

[Claim 5] The stereoscopic stereoscopic photographic surveying target as set forth in any one of Claims 1 through 4, wherein the number of said auxiliary points provided on said first straight line is different from the number of said auxiliary points provided on said second straight line.

[Claim 6] The stereoscopic stereoscopic photographic surveying target as set forth in Claim 5, wherein said auxiliary points are provided by two on said first straight line while said auxiliary point is provided by one on said second straight line.

[Detailed description of the invention]

[0001]

[Field of the invention]

The present invention relates to calculation of a camera position in photogrammetry.

[0002]

[Prior arts]

Conventionally, a stereographic survey has been known in photogrammetry for traffic accident investigations, etc. In a stereographic survey, an accident site is simultaneously photographed by two cameras located at a prescribed distance, a stereo image thus obtained is entered into a stereoscopic vision by an optical apparatus, and points in the stereo image are designated as surveying points, wherein the coordinates of the respective surveying points are calculated. In order to calculate the surveying points, position information of the two cameras that picked up the image, that is, information such as the distance from the cameras to the subject and angles of the camera with respect to the subject, etc., is requisite. Therefore, it is necessary for staff in charge to meter and record the position information of the cameras at the site at all times.

[0003]

[Objects to be solved by the invention]

However, it is very cumbersome to meter the distances

and angles of the cameras with respect to the subject whenever photographing, and this requires a long period of time and much labor. Therefore, at a site of a traffic accident investigation where quick handling or processing is required, it was difficult to obtain accurate position information of the cameras at all times. Further, since work of producing a stereoscopic vision of a stereo-photographing image by an optical apparatus and designating points in the stereo image depends on the degree of skill or practice, there was another problem in view of work efficiency in survey and surveying accuracy.

[0004]

The present invention has been developed to solve the above-described problems, and it is therefore an object of the invention to provide a stereoscopic photographic surveying target capable of calculating the camera position from a shooting image only by being photographed by a camera together with a subject.

[0005]

[Means for solving the object]

A stereoscopic photographic surveying target according to the invention is featured in that the target is photographed by a camera together with a subject in photogrammetry, has

reference points which are easily distinguished in a shooting image, and is used for calculating the shooting position of said camera by specifying the positions of said reference points in said shooting image,

wherein first, second and third three reference points, the intervals of which are known in advance, are provided as said reference point, a first straight line connecting said first reference point and said second reference point to each other and a second line connecting said second reference point and said third reference point to each other have a prescribed angle, and an auxiliary point which is easily distinguished in the shooting image as in said reference points is provided on said first straight line and said second straight line.

[0006]

Preferably, the distance between said first reference point and said second reference point is equal to that between said second reference point and said third reference point.

[0007]

Preferably, the prescribed angle between the first straight line connecting the first reference point and the second reference point and the second straight line connecting the second reference point and the third reference point is a right angle.

[0008]

Preferably, said first reference point, said second reference point and said auxiliary point are positioned equidistantly from each other on said first straight line, and said second reference point, said third reference point and auxiliary point are positioned equidistantly from each other on said second straight line.

[0009]

Preferably, the number of said auxiliary points provided on said first straight line is different from the number of said auxiliary points provided on said second straight line.

[0010]

Preferably, said auxiliary points are provided by one on said first straight line while said auxiliary point is provided by two on said second straight line.

[0011]

[Embodiments of the invention]

Hereinafter, although a description is given of embodiments of a stereoscopic photographic surveying target according to the invention with reference to the accompanying drawings, a description is given in advance of an example of photographing surveying using a stereoscopic photographic surveying target according to the invention.

[0012]

Fig. 1 shows a positional relationship between a stereoscopic photographic surveying target (hereinafter called a "target") 10, a cube 102 being a subject, and cameras 100. The cube 102 and target 10 are photographed at both the first camera position M_1 and second camera position M_2 by the cameras 100. The first camera position M_1 and second camera position M_2 are defined as the principal-point positions of the rear side of the photographing lens of the respective cameras 100. The first camera position M_1 is shown with a solid line, and the second camera position M_2 is shown with a broken line, wherein the optical axes at the respective camera positions M_1 and M_2 are shown with one-dotted chain lines O_1 and O_2.

[0013]

The target 10 is L-shaped, in which two pillar-shaped members are connected to each other. Three reference point members and three auxiliary point members are provided on the target 10. However, in order to avoid complication of the drawing, only the three reference point members being vertices are used for description. These three vertices are defined to be reference point members P_1, P_2 and P_3. The plane determined by the reference point members P_1, P_2 and P_3 is made into a

reference plane, and the distance between the reference point member P_1 and reference point member P_2 is shown as a reference scale L. Also, the distance between the reference point members P_1 and P_2 is equal to the distance between the reference point members P_2 and P_3, and an angle created by sides P_1, P_2 and P_1 and P_2 is 90 degrees.

[0014]

Fig. 2(a) shows an image picked up at the first camera position M_1, that is, the first image, and Fig. 2(b) shows an image picked up at the second camera position M_2, that is, the second image. The first two-dimensional orthogonal coordinate system (x_1, y_1) is established with respect to the first image, and the coordinate origin is determined at the photographing center c_1 of the first image. As has been made clear in Fig. 2(a), in the first image, image points of the reference point members P_1, P_2 and P_3 are expressed by respective coordinates p_{11} (px_{11}, py_{11}), p_{12} (px_{12}, py_{12}), and p_{13} (px_{13}, py_{13}).

[0015]

The second two-dimensional orthogonal coordinate system (x_2, y_2) is established with respect to the second image, and the coordinate origin is determined at the photographing center c_2 of the second image. As has been made clear in Fig. 2(b), in the second image, image points of the reference point members

P_1, P_2 and P_3 are expressed by respective coordinates P_{21} (px_{21}, py_{21}), p_{22} (px_{22}, py_{22}) and p_{23} (px_{23},py_{23}).

[0016]

Respective coordinates of the reference point members P_1, P_2 and P_3 on the first and second images may be expressed by p_{ij} (px_{ij},py_{ij}). Herein, a variable i indicates the number of images, i=1 corresponds to the first image in Fig. 2(a), and i=2 corresponds to the second image in Fig. 2(b). Also, a variable j is coincident with the number of the reference point members P_j. In the embodiment, j=1, 2, and 3 is established.

[0017]

Fig. 3 relatively shows the positional relationship between the first and second images and the target 10 when executing photographing by the camera 100. At this time, the distance between the reference point member P_1 and the reference point member P_2 on the target 10 is made into a relative length. The length is expressed by L'. In addition, the reference plane regulated by the reference point members P_1, P_2 and P_3 is shown to be a hatched area.

[0018]

Here, in order to specify the three-dimensional position of the cube 102 on the basis of the first and second images, a three-dimensional orthogonal coordinate system (X,Y,Z) is

appropriately established. In Fig. 3, the three-dimensional orthogonal coordinate system is a right-handed system, the coordinate origin is made coincident with the first camera position M_1. In addition, the Z axis is made coincident with the optical axis O_1 at the first camera position M_1.

[0019]

At this time, the three-dimensional coordinate of the second camera position M_2 is expressed by (X_o, Y_o, Z_o) and indicates the amount of displacement of the second camera position M_2 with respect to the first camera position M_1. Also, the three-dimensional angular coordinate of the optical axis O_2 at the second camera position M_2 is expressed by (α, β, γ), and the three-dimensional angular coordinate indicates the rotation angle of the optical axis O_2 with respect to the optical axis O_1. That is, α shows an angle created with respect to the X axis of the three-dimensional orthogonal angular coordinate, β shows an angle created with respect to the Y axis of the three-dimensional orthogonal angular coordinate, and γ shows an angle created with respect to the Z axis of the three-dimensional orthogonal angular coordinate.

[0020]

Also, in Fig. 3, the respective three-dimensional coordinates of three reference point members P_1, P_2 and P_3 at

the three-dimensional orthogonal coordinate system (X, Y, Z) are expressed by P_1 (PX_1, PY_1, PZ_1), P_2 (PX_2, PY_2, PZ_2), and P_3 (PX_3, PY_3, PZ_3), and these three-dimensional coordinates may be expressed as P_j (PX_j, Py_j, PZ_j) (j= 1,2 and 3).

[0021]

As has been made clear in Fig. 3, the respective reference point members P_j, the image point p_{ij} on the first or second image, the first and second camera positions M_1 and M_2 are located on the same straight line. Therefore, the three-dimensional coordinates P_j (PX_j, PY_j, PZ_j) may be obtained by using the collinear equation shown in the following expression (1).

[0022]

[Expression 1]

$$\left.\begin{aligned} PX_j &= (PZ_j - Zo)\frac{a_{11}px_{ij} + a_{21}py_{ij} - a_{31}C}{a_{13}px_{ij} + a_{23}py_{ij} - a_{33}C} + Xo \\ PX_j &= (PZ_j - Zo)\frac{a_{12}px_{ij} + a_{22}py_{ij} - a_{32}C}{a_{13}px_{ij} + a_{23}py_{ij} - a_{33}C} + Yo \end{aligned}\right\} \quad (1)$$

however,

$$a_{11} = \cos\beta \bullet \sin\gamma$$

$$a_{12} = -\cos\beta \bullet \sin\gamma$$

$$a_{13} = \sin\beta$$

$$a_{21} = \cos\alpha \bullet \sin\gamma + \sin\alpha \bullet \sin\beta \bullet \cos\gamma$$

$$a_{22} = \cos\alpha \bullet \cos\gamma - \sin\alpha \bullet \sin\beta \bullet \sin\gamma$$

$$a_{23} = -\sin\alpha \bullet \cos\beta$$

$$a_{31} = \sin\alpha \bullet \sin\gamma + \cos\alpha \bullet \sin\beta \bullet \cos\gamma$$

$$a_{32} = \sin\alpha \bullet \cos\gamma + \cos\alpha \bullet \sin\beta \bullet \sin\gamma$$

$$a_{33} = \cos\alpha \bullet \cos\beta$$

[0023]

In addition, C in the above-described expression (1) is the principal-point distance (focal distance) of a photographing lens of the camera 100, and is the same in the first and second images. That is, the principal-point distance C is the distance between the first camera position (rear-side principal-point position) M_1 and the photographing center c_1 or the distance between the second camera position (rear-side principal-point position) M_2 and the photographing center c_2.

[0024]

With reference to the flowchart of Fig. 4, a description is given of a survey map preparing routine to produce a survey map on the basis of the first and second images. The survey map preparing routine is executed by a computer into which the first and second images are taken as video data. At this time, the first and second images (Fig. 2(a) and Fig. 2(b)) are displayed on the display screen of a monitor device connected to the computer.

[0025]

First, in Step S101, with respect to an unknown variable in the above-described collinear equation (1), that is, the displacement amount (X_o, Y_o, Z_o) of the second camera position M_2 for the first camera position M_1 and rotation angle (α,β,γ) of the optical axis O_2 for the optical axis O_1, an appropriate value except 0 is inputted into the computer as a default. And, it is inputted into the computer by operation of, for example, a keyboard.

[0026]

In step S102, two-dimensional coordinates p_{1j} (px_{1j}, py_{1j}) and p_{2j} (px_{2j}, py_{2j}), corresponding to each other, of image points of the reference point members P_j on the first and second images displayed on the monitor device are inputted into the computer one after another. Also, the two-dimensional coordinates p_{1j} (px_{1j}, py_{1j}) and p_{2j} (px_{2j}, py_{2j}) are inputted by operating, for example, a mouse while pointing to and clicking the image points of the respective reference point members P_j on the first and second images of the monitor device.

[0027]

In step S103, 1 is given to a counter k as a default. Next, in step S104, an optional object point $Q_{k=1}$ (Fig. 1) on the cube 102, which is a subject, is selected, and two-dimensional coordinates q_{1k} (qx_{1k}, qy_{1k}) and q_{2k} (qx_{2k}, qy_{2k}),

corresponding to each other, of image points of object points $Q_{k=1}$ on the first and second images displayed on the monitor device are inputted into the computer one after another. Also, the two-dimensional coordinates q_{1k} (qx_{1k}, qy_{1k}) and q_{2k} (qx_{2k}, qy_{2k}) are inputted by operating a mouse while pointing to and clicking the image points of the respective object points $Q_{k=1}$ on the first and second images of the monitor device.

[0028]

The positional relationsihp between the object point $Q_{k=1}$, the image point of the object point Q_j on the first and second images, and the first and second camera positions M_1 and M_2 is similar to the positional relationship between the respective reference point members P_j shown in Fig. 3, the image points p_{ij} on the first and second images thereof, and the first and second camera positions M_1 and M_2, wherein the image points of the object point $Q_{k=1}$ and object point Q_j and the first and second camera positions M_1 and M_2 are located on a straight line. Therefore, the three-dimensional coordinates Q_1 (Q_{X1}, Q_{Y1}, Q_{Z1}) of the object point $Q_{k=1}$ may be obtained by using the expression (1).

[0029]

In step S105, on the basis of input data of the two-dimensional coordinates p_{1j} (px_{1j}, py_{1j}) and p_{2j} (px_{2j}, py_{2j}) and

the two-dimensional coordinate q_{1k} (qx_{1k}, qy_{1k}) and q_{2k} (qx_{2k}, qy_{2k}), the above-described collinear equation (1) is solved by a successive approximate analysis. The three-dimensional coordinates P_j (PX_j, PY_j, PZ_j) of the respective reference point members P_j (j=1, 2, and 3), three-dimensional coordinates Q_1 (QX_1, QY_1, QZ_1), unknown variables (X_o, Y_o, Z_o) and (α, β, γ) are approximately obtained.

[0030]

The successive approximate analysis is a method by which a compensation amount of the unknown variable is obtained by the least squares method by giving defaults to the unknown variables (X_o, Y_o, Z_o) and (α, β, γ) in the above-described collinear equation and securing linearization through Taylor series development around the defaults. By repeating such approximate analysis, the approximate value of further fewer errors can be obtained with respect to the unknown variables.

[0031]

In summary, the three-dimensional coordinates P_j (PX_j, PY_j, PZ_j) of the reference point members P_j (j=1, 2, and 3) are obtained on the basis of the two-dimensional coordinates p_{1j} (px_{1j}, py_{1j}) of the reference point member P_j on the first image, and the two-dimensional coordinates p_{2j} (px_{2j}, py_{2j}) of the reference point member P_j on the second image, and the

three-dimensional coordinates Q_1 (QX_1, QY_1, QZ_1) of the object point $Q_{k=1}$ are obtained on the basis of the two-dimensional coordinates q_{1k} (qx_{1k}, qy_{1k}) of the object point $Q_{k=1}$ on the first image and the two-dimensional coordinates q_{2k} (qx_{2k}, qy_{2k}) of the object point $Q_{k=1}$ on the second image, whereby the approximate values concerning the displacements (X_o, Y_o, Z_o) of the second camera position M_2 and the rotation angles (α, β, γ) of the optical axis O_2 can be obtained.

[0032]

In step S106, a compensation magnification m is obtained, which compensates a relative distance on the coordinate values to a real distance. The calculation uses an already-known distance, for example, the distance between the reference point member P_1 and reference point member P_2. Since the actual distance between the reference point member P_1 and the reference point member P_2 is L (refer to Fig. 1), the following expression can be established between the distance L′ (refer to Fig. 3) between the reference point member P_1 and reference point member P_2 in the three-dimensional orthogonal coordinate system (X, Y, Z) and the actual distance L.

[0033]

$L = L' \times m$ (m: compensation magnification)

[0034]

In step S107, scaling is carried out by using the above-described compensation magnification, whereby a disposition relation may be obtained on the actually measured values between the three-dimensional coordinates P_j (PX_j, PY_j, PZ_j) of the reference point member P_j and the three-dimensional coordinates Q_1 (QX_1, QY_1, QZ_1) of the object point $Q_{k=1}$.

[0035]

In step S108, the three-dimensional orthogonal coordinate system (X, Y, Z) is converted into, in terms of coordinates, the three-dimensional orthogonal coordinate system (X′, Y′, Z′) as shown in Fig. 5. As has been made clear in the same drawing, the coordinate origin of the three-dimensional orthogonal coordinate system (X′, Y′, Z′) is made coincident with the reference point member P_1, the X′ axis thereof is made coincident with a straight line connecting the reference point members P_1 and P_2, and further the plane X′-Z′ is made coincident with the plane Ps including the reference plane (shown as a hatched area in the drawing). In addition, although the reference point member P_1 is selected as the coordinate origin of the three-dimensional orthogonal coordinate system (X′, Y′, Z′), any optional point on the plane Ps may be made into the coordinate origin of the three-dimensional orthogonal coordinate system (X′, Y′, Z′).

[0036]

In step S109, the plane X′-Z′ is displayed as a survey view on the monitor device. At this time, a projection point of the object point $Q_{k=1}$ is displayed on the plane X′-Z′, that is, the survey view together with the reference point members P_1, P_2 and P_3. Also, the survey view is not limited to the plane X′-Z′, but it may be the plane X′-Y′ or Y′-Z′. Further, it may be a stereo-perspective view on the basis of the three-dimensional orthogonal coordinate system (X′, Y′, Z′).

[0037]

In step S110, it is judged whether or not another object point is selected with respect to the cube 102. Where another object point is further selected, the process advances to step S111, wherein the value of the counter k is progressed by "1". After that, the process advances to step S104, wherein the two-dimensional coordinates q_{1k} (qx_{1k}, qy_{1k}) and q_{2k} (qx_{2k}, qy_{2k}), corresponding to each other, of images of the object point $Q_{k=2}$ (not illustrated) on the first and second images, which are displayed on the monitor device, are inputted into the computer.

[0038]

In step S105, the above-described collinear equation (1) is solved by a successive approximate analysis on the basis

of input data of the two-dimensional coordinates p_{1j} (px_{1j}, py_{1j}) and p_{2j} (px_{2j}, py_{2j}) and two-dimensional coordinates q_{1k} (qx_{1k}, qy_{1k}) and q_{2k} (qx_{2k}, qy_{2k}), whereby the three-dimensional coordinates P_j(PX_j, PY_j, PZ_j) of the respective reference point members P_j (j=1, 2, and 3), the three-dimensional coordinates Q_k (Q_{xk}, Q_{yk}, Q_{zk}) of the object point Q_k, unknown variables (X_o, Y_o, Z_o) and (α, β, γ) are approximately obtained. The approximate values of the unknown variables (X_o, Y_o, Z_o) and (α, β, γ) will become even more approximate than before.

[0039]

In summary, the more the number of object points Q_k is increased, the closer the approximate values of the unknown variables (X_o, Y_o, Z_o) and (α, β, γ) become to the actual values. In order to obtain reasonable approximate values, at least five points are required, including the reference point members P_1, P_2 and P_3.

[0040]

Fig. 6 is a partially broken view of an embodiment of a stereoscopic photographic surveying target according to the invention. Fig. 7 is a side elevational view of the stereoscopic photographic surveying target. The target 10 exhibits an L-shaped form, and is provided with two pillar-shaped members 12 and 14. The first pillar-shaped member 12 and second

pillar-shaped member 14 are made of a metal material, the interior of which is hollow, and the form of which is square pillar-shaped. And, a non-reflection sheet is attached to the entire circumferential side thereof. The widths L_w of the first and second pillar-shaped members 12 and 14 are roughly equal to each other, and the respective thicknesses L_H thereof are equal to each other.

[0041]

An adhesive agent is adhered to the planes of the non-reflection sheet, which are brought into close contact with the first and second pillar-shaped members 12 and 14 while the opposite planes thereof are black. Further, minute projections and dents are formed on the surface thereof. Since incident light is absorbed and diffused by the projections and dents, the reflection light volume can be remarkably decreased. Also, non-reflection coating such as, for example, a delustered black coating, etc., may be coated on the surface of the first and second pillar-shaped members 12 and 14 instead of the non-reflection sheet.

[0042]

A rectangular parallelepiped control portion casing 20 is integrally fixed at one end 12a of the first pillar-shaped member 12. The control portion casing 20 is formed of a metal

material, and a non-reflection sheet is adhered to the entire circumferential side thereof. At the control portion casing 20, the thickness is the same length L_H as the thickness of the first pillar-shaped member 12, and the width is larger by approximately two times than the width L_W of the first pillar-shaped member 12. The control portion casing 20 is provided so that the side 20b thereof is positioned on the same plane as the side 12b of the first pillar-shaped member 12, the side 20c of the control portion casing 20 protrudes from the side 12c of the first pillar-shaped member 12.

[0043]

One end 14a of the second pillar-shaped member 14 is rotatably mounted on the side 20c of the control portion casing 20 by means of a hinge 15. The side 14b of the second pillar-shaped member 14 is positioned on the same plane as that of the end 20d at the opposite side of the plane on which the first pillar-shaped member 12 is secured.

[0044]

A stay 16 which is a fixing member is connected at the side of the angle α that is created by the side 14c of the second pillar-shaped member 14 and the side 20c of the control portion casing 20, that is, at the side of an acute angle that is created by the axial centers A and B (shown by a two-dashed chain line

in the drawing) of the two pillar-shaped members 12 and 14, whereby the two pillar-shaped members 12 and 14 are fixed to each other. The width and thickness of the stay 16 are smaller than the width L_W and thickness L_H of the first and second pillar-shaped members 12 and 14. In addition, the length of the stay in its lengthwise direction is shorter than the length of the first pillar-shaped member 12 in its lengthwise direction.

[0045]

The stay 16 is provided so as to be inclined with respect to the two pillar-shaped members 12 and 14. At this time, the angle α created by the second pillar-shaped member 14 to the first pillar-shaped member 12 is 90 degrees. The stay 16 is rotatably secured on the first pillar-shaped member 12 by means of a stay hinge 92, and is detachable from the second pillar-shaped member 14 by a lock hinge 94.

[0046]

Three reference point members 31, 34 and 36 and three auxiliary point members 32, 33 and 35 are provided on the same plane on the upper surface of the target 10, that is, on the upper surface of the two pillar-shaped members 12 and 14 and the control portion casing 20. The reference point member 31 (the first reference point) and auxiliary point members 32 and

33 are provided on the upper surface 12e of the first pillar-shaped member 12, the reference point member 34 (the second reference point) is provided on the upper surface 20e of the control portion casing 20, and the auxiliary point member 35 and reference point member 36 (the third reference point) are provided on the upper surface 14e of the second pillar-shaped member 14. That is, two auxiliary point members 32 and 33 are provided on a straight line (the first straight line) connecting the reference point member 31 and reference point member 34 while one auxiliary point member 35 is provided on a straight line (the second straight line) connecting the reference point member 34 and reference point member 36.

[0047]

The respective reference point members 31, 34 and 36 and respective auxiliary point members 32, 33 and 35 are disk-shaped, and the diameters of the members are the same and are smaller than the widths L_w of the pillar-shaped members 12 and 14.

[0048]

The reference point members 31 and 34 and auxiliary point members 32 and 33 are provided on a straight line (the first straight line) connecting the reference point member 31 and the reference point member 34, which are parallel to the axial

center A direction while the reference point members 34 and 36 and auxiliary point member 35 are provided on a straight line (the second straight line) connecting the reference point member 34 and reference point member 36, which are parallel to the axial center B direction. That is, two auxiliary point members 32 and 33 are provided on a straight line connecting the reference point member 31 and reference point member 34 while one auxiliary point member 35 is provided on a straight line connecting the reference point member 34 and reference point member 36, wherein the numbers of auxiliary point members disposed on the respective straight lines differ from each other. The distances between the reference point member 31 and auxiliary point member 32, between the auxiliary point member 32 and auxiliary point member 33, and between the auxiliary point member 33 and reference point member 34 are equal to each other, and the distances between the reference point member 34 and auxiliary point member 35 and between the auxiliary point member 35 and reference point member 36 are equal to each other. Also, the distance from the reference point member 31 to the reference point member 34 is equal to the distance from the reference point member 34 to the reference point member 36.

[0049]

The reference plane of a photographic survey is

determined by the reference point members 31, 34 and 36 and auxiliary point members 32, 33 and 35. Simultaneously, side lengths of isosceles triangles, the vertices of which are the reference point members 31, 34 and 36 are determined as reference scales. That is, the distance (length L shown in Fig. 1) from the reference point member 31 to the reference point member 34, distance from the reference point member 34 to the reference point member 36, or distance from the reference point member 36 to the reference point member 31 are already known and are used for photographic survey as the reference scales.

[0050]

Also, the angle α is not limited to 90 degrees, and the distance between the reference point members 31 and 34 and the distance between the reference point members 34 and 36 may not be equal to each other. The angle α, distance between the reference point members 31 and 34 and distance between the reference point members 34 and 36 may be any already known values. However, where simplicity of calculation processing is taken into consideration, it is preferable that the angle α is 90 degrees, and the distance between the reference point members 31 and 34 and the distance between the reference point members 34 and 36 are equal to each other as described above.

[0051]

As has been made clear in Fig. 6, since the number of auxiliary point members differ from each other on the two sides of an isosceles triangle, which have an equal length, it is easy to discriminate the orientation of the target 10. Where there are a number of the same photographed images with respect to a subject, the camera positions can be easily conceived.

[0052]

Also, since the intermediate parts of the first and second pillar-shaped members 12 and 14 are linked with each other and fixed by the stay 16, the angle α can be accurately regulated, wherein accuracy of photographic survey can be improved.

[0053]

Further, a sheet-like resilient member 19 (Refer to Fig. 10) is provided as clearance between the side 20c of the control portion casing 20 and the end face 14a of the second pillar-shaped member 14, which is produced by the hinge 15, wherein it is possible to prevent the second pillar-shaped member 14 from shaking. The resilient member 19 may be formed of rubber, sponge, etc., and is closely adhered to and fixed at the end face 14a of the second pillar-shaped member 14 and the side 20c of the control portion casing 20. Also, a spring member may be provided instead of the sheet-like resilient member 19.

[0054]

A reflection sheet is adhered to the reference point members 31, 34, and 36 and auxiliary point members 32, 33 and 35. The surface of the reflection sheet is processed to be smooth and exhibits white, whereby the reflection volume of light is increased. Further, non-reflection members 41, 42, 43, 45 and 46 which are disk-shaped members to which non-reflection sheets are adhered are provided around the respective reference point members 31, 34 and 36 and auxiliary point members 32, 33 and 35. Accordingly, it becomes easy to distinguish the reference point members 31, 34 and 36 and auxiliary point members 32, 33 and 35 on a photographed image, wherein accuracy of a photographic survey can be improved.

[0055]

The target 10 is provided with three legs 18 on the side opposite to the plane where the reference point members 31, 34 and 36 and auxiliary point members 32, 33 and 35 are provided. The legs 18 are provided so as to correspond to the reference point members 31, 34 and 36. The target 10 is placed with spacing equivalent to the length of the legs 18 secured above the road surface, whereby the target 10 is installed in parallel to the road surface without being influenced by projections and dents on the road surface.

[0056]

Referring to Fig. 8 and Fig. 9, a description is given of the configurations of the auxiliary point member 35 and non-reflection member 45. Fig. 8 is a sectional view of the target 10 on the sectional plane taken along the line VIII-VIII in Fig. 6. Fig. 9 is a plan view showing the plane at the second pillar-shaped member 14 side of the non-reflection member 45. Since other reference point members 31, 34 and 36, auxiliary point members 32 and 33, and non-reflection members 41, 42, 43, 44 and 46 are similar to the auxiliary point members 35 and non-reflection member 45 in view of the structure thereof, description is omitted herein.

[0057]

A magnet holding member 62 is provided on the upper surface 14e of the second pillar-shaped member 14, and an annular magnet 64 is accommodated in the interior of the magnet holding member 62. The outer diameter of the magnet holding member 62 has roughly the same dimension as the width L_w of the second pillar-shaped member 14. The magnet 64 is integrally fixed on the second pillar-shaped member 14 by a screw member 66 together with the magnet holding member 62. A reflection sheet 68 is adhered on the head portion 67 of the screw member 66. The auxiliary point 35 is composed of the magnet holding

member 62, magnet 64, screw member 66 and reflection sheet 68.

[0058]

The non-reflection member 45 is provided with a disk 72 formed of a material through which electric waves can be transmitted, such as, for example, resin or rubber. Where the material of the disk 72 is rubber, the non-reflection member 45 can be prevented from being damaged due to dropping. A non-reflection sheet 74 is adhered to one side of the disk 72. In the embodiment, the diameter of the non-reflection member 45 is equivalent to seven times the diameter of the auxiliary point member 35, that is, the screw member head portion 67. Also, the thickness of the non-reflection member 45 is slightly smaller than the thickness of the head portion 67 of the screw member 66.

[0059]

A fitting hole 76 having roughly the same diameter as that of the head portion 67 of the screw member 66 is formed at the middle of the non-reflection member 45. On the plane where the non-reflection sheet 74 of the non-reflection member 45 is not provided, an annular iron plate 78 is embedded around the fitting hole 76. The inner diameter of the iron plate 78 is roughly the same as the diameter of the fitting hole 76, and the outer diameter thereof is roughly the same as the outer

diameter of the magnet holding member 62.

[0060]

The non-reflection member 45 is detachable from the auxiliary point member 35. When the target 10 is used, the head portion 67 of the screw member 66 is fitted in the fitting hole 76. At this time, the iron plate 78 is adhered to and fixed at the head portion 67 of the screw member 66 or the magnet holding member 62 by a magnetic force of the magnet 64. As has been made clear in Fig. 8, the reflection sheet 68 and non-reflection sheet 74 are roughly on the same plane in a state where the non-reflection member 45 is attached to the auxiliary point member 35. When the target 10 is not used, the non-reflection member 45 is manually removed from the auxiliary point member 35.

[0061]

Thus, by making the non-reflection member 45 detachable from the auxiliary point member 35, portability of the target 10 can be improved. Further, by providing the non-reflection sheet 74 around the reflection sheet 68, the area of the auxiliary point member 35 can be made clear, wherein if the pick-up conditions are worse, for example, in picking up at a site where the periphery of said reference point is dark due to raining or at night, or at a site where the road surface

is easily reflected, it becomes easy to distinguish the auxiliary point member 35 in a picked-up image.

[0062]

The ratio of the diameter of the auxiliary point member 35 to that of the non-reflection member 45, that is, the size of the area of the reflection sheet 68 and non-reflection sheet 74, is not limited to the size referred to in the present embodiment. The size may be such that the reflection sheet 68 can be sufficiently identified in a picked-up image of the target 10. In addition, the shape of the auxiliary point member 35 and non-reflection member 45 is not limited to a circle.

[0063]

Fig. 10 is an enlarged plan view of the vicinity of the control portion casing 20 in Fig. 6, and the view is partially broken. Fig. 11 is a sectional view taken along the line XI-XI in Fig. 10, which shows a simplified state of the construction of the control portion casing 20.

[0064]

A battery accommodating chamber 83 is provided at the end face 20d side of the control portion casing 20. A battery 87 that is a power source is accommodated in the battery accommodating chamber 83. The battery 87 supplies power to the target 10. The battery accommodating chamber 83 has an opening

at the end face 20d side and is enclosed by a lid portion 83a. A switch 85 is integrally provided on the end face 20d of the control portion casing 20, and the power is turned on and off by manual operations of the switch 85. If the power is turned on, various types of sensors such as an inclination angle sensor and a direction sensor (not illustrated) operate, and position information of the target 10 can be obtained.

[0065]

The upper plane 20e of the control portion casing 20 is provided with an opening 81. The opening 81 is enclosed by a cover 82. The cover 82 is formed of a material through which electric waves can be transmitted, for example, resin.

[0066]

Fig. 12 is a plan view showing a state where the target 10 is folded in. Fig. 13 is a plan view of the target 10, which shows an intermediate state from an assembled state shown in Fig. 6 to a folded-in state shown in Fig. 12.

[0067]

The target 10 is assembled to be L-shaped and is used as shown in Fig. 6 when carrying out a photographic survey. However, when it is not used, the target 10 is folded to be I-shaped as shown in Fig. 12, for example, when conveying it. First, the non-reflection members 41, 42, 43, 44, 45 and 46

are removed. Next, the stay 16 is removed from a lock pin 94 of the second pillar-shaped member 14. Thereby, the stay 16 becomes rotatable around the stay hinge 92 of the first pillar-shaped member 12, and the second pillar-shaped member 14 is made rotatable around the hinge 15.

[0068]

Further, the stay 16 and the second pillar-shaped member 14 are turned clockwise, that is, in the direction shown by the arrow in Fig. 13, and the stay 16 and the second pillar-shaped member 14 are made roughly parallel to the first pillar-shaped member 12. Since the second pillar-shaped member 14 is attached to the control portion casing 20, and the control portion casing 20 protrudes inward of the target 10 (leftward in Fig. 12) from the first pillar-shaped member 12, clearance D is produced between the first pillar-shaped member 12 and the second pillar-shaped member 14. The stay 16 is accommodated in the clearance D, wherein the clearance D produced in the folding-in of the target 10 can be effectively utilized. Also, when folding in, the lock hinge 94 is located at the control portion casing 20 side by the stay hinge 92 and does not interfere with the stay hinge 92 and stay 16.

[0069]

However, only with the target 10 folded in to be I-shaped,

may it move unintentionally because the stay 16 and the second pillar-shaped member 14 are rotatable with respect to the first pillar-shaped member 12, and there may be a possibility that a malfunction and/or damage may result therefrom. Therefore, the stay 16 and the second pillar-shaped member 14 are fixed at the first pillar-shaped member 12 at respective ends thereof.

[0070]

The first ball plunger 96 is provided in the vicinity of the reference point member 31 at the side 12c of the first pillar-shaped member 12. On the other hand, a keeper 98 is provided in the vicinity of the reference point member 36 at the side 14c of the second pillar-shaped member 14. With the first ball plunger 96 and keeper 98 engaged with each other, the first pillar-shaped member 12 and the second pillar-shaped member 14 are fixed to each other.

[0071]

Fig. 14 is a view showing a fixing mechanism of the first and second pillar-shaped members 12 and 14, which is a sectional view taken along the line XIV-XIV in Fig. 12.

[0072]

The first ball plunger 96 has a recess 104 formed thereon. A projection portion 106 formed on the keeper 98 is engaged

in the recess portion 104. The projection portion 106 has a ridge at its tip end, and thickness of the thickest portion of the ridge portion 106a is slightly smaller than the thickness of the recess portion 104. The thickness of the base end portion 106b of the projection portion 106 is thinner than the ridge portion 106a. In Fig. 14, balls 108 and springs 110 for pressing the balls 108 into the recess portion 104 are, respectively, provided on and under the recess portion 104.

[0073]

If the projection portion 106 of the keeper 98 is pushed in the recess portion 104, the two balls 108 are caused to move apart from the recess portion 104 against a pressing force of the springs 110 by being brought into contact with the ridge portion 106a. If the projection 106 is further pushed into the recess portion 104, the two balls 108 are caused to move to the recess portion 104 side again by a pressing force of the spring 110 and are brought into contact with the base end portion 106b, wherein the projection portion 106 is placed between the two balls 108.

[0074]

By engagement of the keeper 98 with the first ball plunger 96, the second pillar-shaped member 14 is fixed at the first pillar-shaped member 12. Also, where the keeper 98 is removed

from the first ball plunger 96, reverse operations of the above-described operations are carried out, that is, the second pillar-shaped member 14 is pulled from the first pillar-shaped member 12 in the separating direction.

[0075]

Fig. 15 is a view showing a fixing mechanism of the stay 16, and is a sectional view taken along the line XV-XV in Fig. 12. The fixing mechanism of the stay 16 is provided with roughly the same structure as that of the fixing mechanism shown in Fig. 14, and the same components are given the same reference numbers.

[0076]

The second ball plunger 100 is provided at the control portion casing 20 side of the first ball plunger 96 at the side 12c of the first pillar-shaped member 12. The thickness of the stay 16 is smaller than the width of the recess portion 104 formed on the second ball plunger 100, and an accommodation fixing hole 102 is formed on the tip end of the stay 16.

[0077]

As the stay 16 is inserted into the recess portion 104, the two balls 108 are caused to move in a direction separating from the recess portion 104 against a pressing force of the springs 110. As the stay 16 is further inserted, a part of the

respective balls 108 is accommodated in both ends of the accommodation fixing hole 102 and engaged with both the ends. That is, the stay 16 is placed between the two balls 108 by the pressing force of the springs 110 and is fixed on the first pillar-shaped member 12. Also, if reverse operations are executed, the stay 16 can be removed from the first pillar-shaped member 12.

[0078]

As described above, since the target 10 is provided with a fixing mechanism for fixing the second pillar-shaped member 14 and the stay 16 at the first pillar-shaped member 12 when the target 10 is folded in, the second pillar-shaped member 14 and stay 16 are prevented from unintentionally opening, wherein a malfunction and/or damage which may occur in transportation can be prevented.

[0079]

In order to move the target 10 from a folded-in state shown in Fig. 12 to an assembled state shown in Fig. 6, as described above, the first ball plunger 96 is first disengaged from the keeper 98, and the second ball plunger 100 is disengaged from the stay 16. Next, the second pillar-shaped member 14 is turned by approximately 90 degrees centering around the hinge 15, and the resilient member 19 secured at

the end face 14a is brought into contact with the side 20c of the control portion casing 20 (See Fig. 10). Next, the stay 16 is turned centering around the stay hinge 92, and the end portion is engaged with the locking hinge 94, thereby causing the first and second pillar-shaped members 12 and 14 to be coupled to each other.

[0080]

Fig. 16 is a partially broken plan view of the construction of the vicinity of the stay hinge 92, and is a partially enlarged view of Fig. 6. Fig. 17 is a sectional view taken along the line XVII-XVII in Fig. 16.

[0081]

The stay hinge 92 is provided between the auxiliary point member 33 and auxiliary point member 32 (See Fig. 6) and is fixed at the side 12c of the first pillar-shaped member 12 by a screw 120. A stay accommodation groove portion 122 is formed on the stay hinge 92, and the end portion 16a of the stay 16 is fitted in the stay accommodation groove portion 122. The thickness of the stay accommodation groove portion 122 is slightly larger than the thickness of the stay 16.

[0082]

Fulcrum holes 126 and 128 to pass a fulcrum pin 124 therethrough are formed on the stay hinge 92 and stay 16. The

fulcrum pin 124 is pressure-fitted into and fixed in the fulcrum hole 126 of the stay hinge 92 and passes through the fulcrum hole 128 of the stay 16. With the above-described construction, the stay 16 is made rotatable in the stay accommodation groove portion 122.

[0083]

Fig. 18 is a partially broken plan view showing the construction of the vicinity of the lock hinge 94, and is a partially enlarged view of Fig. 6. Fig. 19 is a sectional view showing a state before the stay 16 is engaged with the lock hinge 94. Fig. 20 is a sectional view showing a state where the stay 16 is engaged with the lock hinge 94, and is a sectional view taken along the line XX-XX of Fig. 18.

[0084]

The lock hinge 94 is provided between the auxiliary point member 35 and the second reference point member 34 (See Fig. 6), and is fixed at the side 14c of the second pillar-shaped member 14 by the screw 130. A stay accommodation groove portion 132 is formed on the lock hinge 94, and a guide member 134 which is a resilient material such as sheet-like rubber or sponge is adhered to and fixed at the side 132a of the stay accommodation groove portion 132 parallel to the side 14c. Also, the guide member 134 may be composed of rubber or sponge or

may be such that a plate member secured in parallel to the side 132a is pressed by a spring in a direction separating from the side 132a. The end portion 16b of the stay 16 is detachable in the stay accommodation groove portion 132. The thickness of the stay accommodation groove portion 132 is slightly larger than the thickness of the stay 16.

[0085]

A fitting hole 138 through which the lock pin 136 passes is formed downward of the stay accommodation groove portion 132 in Fig. 19. A pin accommodation portion 137 for accommodating the lock pin 136 is formed upward of the stay accommodation groove portion 132, and a fitting hole 140 whose diameter is roughly the same as that of the fitting hole 138 and coaxial therewith is formed in the pin accommodation portion 137. An opening 141 whose diameter is smaller than that of the fitting hole 140 is formed on the upper wall 137a of the pin accommodation portion 137.

[0086]

The lock pin 136 is provided with a head portion 142, an engagement portion 144 having roughly the same diameter as that of the fitting holes 138 and 140, and an intermediate portion 146 that is provided between the head portion 142 and the engagement portion 144 and has roughly the same diameter

as that of the opening 141. A spring 148 is provided at the surrounding of the intermediate portion 146 in the fitting hole 140. One end of the spring 148 is brought into contact with the upper wall 137a of the pin accommodation portion 137, and the other end thereof is brought into contact with the upper surface 144a of the engagement portion 144. The spring 148 vertically presses the engagement portion 144, that is, the lock pin 136.

[0087]

The lock pin 136 relatively moves in the vertical direction. If the head portion 142 is manually raised, the spring 148 is compressed in line by elevation of the upper plane 144a and is moved to the position shown in Fig. 19. At this time, the lower end of the engagement portion 144 is positioned upward of the stay accommodation groove portion 132, and the stay 16 is inserted into the stay accommodation groove portion 132.

[0088]

A lock hole 150 having a slightly larger diameter than that of the engagement portion 144 is formed at the end portion 16b of the stay 16. An inclination plane 16c inclined with respect to the side in the lengthwise direction is formed at the corner of the end portion 16b. The inclination plane 16c

is caused to slide with respect to the guide member 134 while pressing the guide member 134 when inserting the stay 16 into the stay accommodation groove 132.

[0089]

With the lock pin 136 raised to the position shown in Fig. 19, the stay 16 is caused to slide in the stay accommodation groove portion 132, and the position of the lock hole 150 is made coincident with the fitting holes 138 and 140. If the raised head portion 142 is released after these are made coincident, the lock pin 136 passes through the lock hole 150 by a pressing force of the spring 148 as shown in Fig. 20 and is engaged with the fitting hole 138. At this time, the head portion 142 is stopped by the upper wall 137a of the pin accommodation portion 137, and the lock pin 136 is prevented from falling down.

[0090]

Thus, by causing the lock pin 136 to be fitted in the lock hole 150 and fixing the stay 16 at the second pillar-shaped member 14, the first and second pillar-shaped members 12 and 14 can be integrally coupled to each other by the stay 16.

[0091]

Since the resilient member 19 is provided between the

control portion casing 20 and the second pillar-shaped member 14 and the guide member 134 is provided between the stay 16 and the second pillar-shaped member 14, coupling of the first and second pillar-shaped members 12 and 14 by means of the stay 16 is well stabilized, and dimensional accuracy of the target 10 can be improved.

[0092]

After the first and second pillar-shaped members 12 and 14 are coupled to the stay 16, non-reflection members 41, 42, 43, 44, 45 and 46 are attached to the reference point members 31, 34, and 36 and auxiliary point members 32, 33 and 35, respectively, the target 10 is entered into an assembled state shown in Fig. 6 and is used for stereoscopic photographic surveying.

[0093]

As described above, in an assembled state according to the present embodiment, two auxiliary point members 32 and 33 are disposed on a straight line connecting the reference point member 31 and reference point member 34 together, and one auxiliary point member 35 is disposed on a straight line connecting the reference point member 34 and reference point member 36 together. That is, the auxiliary point members on the respective straight lines differ from each other in number.

Therefore, even if the first and second pillar-shaped members 12 and 14 are blurred in a picked-up image and it is difficult to confirm the members, relative positional relationship of the reference point members 31, 34 and 35 can be easily recognized.

[0094]

Further, since the reference point members and auxiliary point members are equidistantly positioned on the straight line connecting the reference point member 31 and the reference point member 34 and straight line connecting the reference point member 34 and reference point member 36, automatic extraction of the reference points can be easily carried out in stereoscopic photographic surveying, and calculation of the camera position can be automatically carried out when having picked up an image.

[0095]

In an assembled state, respective components such as the hinge 15, stay hinge 92, lock pin 94, the first and second ball plungers 96 and 100, and keeper 98 are covered up with the non-reflection members 41, 42, 43, 44, 45 and 46 so that the components are not photographed in a picked up image. Therefore, it becomes possible to further easily identify the reference point members 31, 34, and 36 and auxiliary point members 32,

33 and 35, wherein accuracy of the stereoscopic photographic surveying can be improved.

[0096]

As described above, in the target 10 according to the embodiment, the reference point members 31, 34 and 36 and auxiliary point members 32, 33 and 35 are further emphasized by providing a reflection sheet on the reference point members 31, 34 and 36 and auxiliary point members 32, 33 and 35 and providing non-reflection members 41, 42, 43, 44, 45 and 46 on the surrounding thereof. Therefore, identification of the reference point members can be made further easy in a picked-up image, and accuracy of the photographic survey can be improved.

[0097]

Further, since the non-reflection members 41, 42, 43, 44, 45 and 46 are detachable, and the target 10 can be folded in from an L-shaped state to an I-shaped state, maneuverability and portability thereof can be improved. Where the target 10 is L-shaped, precise dimensional accuracy of the target can be obtained by fixing the first and second pillar-shaped members 12 and 14 by the stay 16. Where the target 10 is I-shaped, since the stay 16 and the second pillar-shaped member 14 are fixed on the first pillar-shaped member 12 by means of the first and second ball plungers 96 and 100, portability

thereof can be improved.

[0098]

[Effects of the invention]

As described above, according to the invention, it is possible to obtain a photographing surveying target by which the camera position can be calculated from a picked-up image by only being picked up by the camera together with a subject in photographic survey.

[Brief description of the drawings]

[Fig. 1] is a perspective view showing the positional relationship between a stereoscopic photographic surveying target according to an embodiment of the invention, subject and camera;

[Fig. 2] is an exemplary view showing an image picked up by a camera in Fig. 1, wherein Fig. 2(a) is the first image picked up at the first camera position by using the camera shown in Fig. 1, and Fig. 2(b) is the second image picked up at the second camera position shown in Fig. 1;

[Fig. 3] is a view showing, in three-dimensional coordinates, the positional relationship between the reference point members, image point thereof, and the rear side principal-point position of the photographing lens of the camera;

[Fig. 4] is a flowchart showing the routine for preparing a survey map of a subject from two images in Fig. 2;

[Fig. 5] is a view showing the three-dimensional coordinates based on a plane including the reference shape;

[Fig. 6] is a plan view showing an embodiment of a stereoscopic photographic surveying a target according to the invention;

[Fig. 7] is a side elevational view of a stereoscopic photographic surveying target shown in Fig. 6;

[Fig. 8] is a sectional view of target, which is taken along the line VIII-VIII in Fig. 6;

[Fig. 9] is a plan view showing a side at the second pillar-shaped member side of a non-reflection member of the target shown in Fig. 6;

[Fig. 10] is a partially broken and enlarged plan view showing the vicinity of a control portion casing of the target shown in Fig. 6,

[Fig. 11] is a sectional view taken along the line XI-XI in Fig. 10, which shows a simplified state of the construction of the control portion casing;

[Fig. 12] is a plan view showing a folded-in state of the target shown in Fig. 6;

[Fig. 13] is a plan view of the target, showing an

intermediate state from an assembled state shown in Fig. 6 to a folded-in state shown in Fig. 12;

[Fig. 14] is a view showing a fixing mechanism of the first and second pillar-shaped members of the target shown in Fig. 6, which is a sectional view taken along the XIV-XIV in Fig. 12;

[Fig. 15] is a view showing a fixing mechanism of the stay of the target shown in Fig. 6, which is a sectional view taken along the line XV-XV in Fig. 12;

[Fig. 16] is a partially broken plan view showing the construction of the vicinity of the stay hinge of the target shown in Fig. 6, which is also a partially enlarged view of Fig. 6;

[Fig. 17] is a sectional view taken along the line XVII-XVII in Fig. 16;

[Fig. 18] is a partially broken plan view showing the construction of the vicinity of the lock hinge of the target shown in Fig. 6, which is also a partially enlarged view of Fig. 6;

[Fig. 19] is a sectional view showing a state before the stay is engaged with the lock hinge of the target shown in Fig. 6; and

[Fig. 20] is a sectional view showing a state where the

stay is engaged with the lock hinge of the target shown in Fig. 6, which is a sectional view taken along the line XX-XX in Fig. 18.

[Description of reference numbers]

10 Target

12 First pillar-shaped member

14 Second pillar-shaped member

15 Hinge

16 Stay

20 Control portion casing

31, 32, 33, 34, 35, 36 Reference point members

41, 42, 43, 44, 45, 46 Non-reference members

92 Stay hinge

94 Lock hinge

[Title of the document] Abstract

[Summary]

[Object] To provide a stereoscopic photographic surveying target capable of calculating a camera position based on a picked up image.

[Solving means] The reference point members 31 and 34 and auxiliary point members 32 and 33 are provided on a straight line connecting the reference point members 31 and 34, and the reference point members 34 and 36 and auxiliary point members 35 are provided on a straight line connecting the reference point members 34 and 36. The distances between the reference point 31 and auxiliary point member 32, between the auxiliary point members 32 and 33, and between the auxiliary point member 33 and reference point member 34 are equal to each other. Also, the distances between the reference point 34 and auxiliary point member 35 and between the auxiliary point member 35 and reference point member 36 are equal to each other. The distance from the reference point member 31 to the reference point member 34 is equal to the distance from the reference point 34 to the reference point member 36.

[Selective drawing] Fig. 6